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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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EXAMINER

LIGHTFOOT, ELENA TSOY

ART UNIT

PAPER NUMBER

1792

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PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No. 10/694,172	Applicant(s) UENO ET AL.	
	Examiner Elena Tsoy Lightfoot	Art Unit 1792	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 06 February 2009.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-5,7 and 9-20 is/are pending in the application.
- 4a) Of the above claim(s) 1-5 and 12-17 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 7,9-11 and 18-20 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
 Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
 If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) Paper No(s). _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ | 6) <input type="checkbox"/> Other: _____ |

The Request for Reconsideration

The Request for Reconsideration filed on February 6, 2009 has been entered. Claims 1-5, 7 and 9-20 are pending in the application. Claims 1-5 and 12-17 are withdrawn from consideration as directed to a non-elected invention.

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

2. Claims 7, 9 and 18-20 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Lee et al (US 6180523) in view of Sambucetti et al (US 6335104), further in view of Whitlow et al (US 5330088), Aisaka et al (JP 04297001) and Semkow et al (US 6,060,176) for the reasons of record set forth in paragraph 2 of the Office Action mailed on 11/7/2008.

3. Claims 9-11 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Lee et al in view of Sambucetti et al, further in view of Whitlow et al, Aisaka et al and Semkow et al, as applied above, and further in view of Neary (US 4424805) and Vullaume et al (Applied Physics Letters, vol. 69, pages 1646-1648, 1996) described by Wada et al (US 20050056828)* for the reasons of record set forth in paragraph 3 of the Office Action mailed on 11/7/2008.

Response to Arguments

Applicant's arguments filed February 6, 2009 have been fully considered but they are not persuasive.

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(A) Applicants disagree that Whitlow, Aisaka and Semkow allegedly cure the deficiency of Lee in view of Sambucetti. The Examiner acknowledges that Lee in view of Sambucetti do not teach a plating film of NiReP. The Examiner cites Whitlow as allegedly teaching that diffusion of copper into a contact can be prevented by placing an impermeable barrier layer between the braze material and the contact. In FIG. 3 of Whitlow, there is shown a copper electrode 27, a braze material 25, a nickel transition layer 33, a molybdenum barrier layer 35 and a contact 31. (See Whitlow at col. 3, 11.56-60.) Further, the Examiner cites Whitlow at column 1, lines 51-65, as disclosing that the material for the barrier may be any element or alloy which does not alloy with the species that is being prevented from diffusing into the contact material, such as tungsten (W) and rhenium (Re), among other listed elements. The Examiner asserts that it would allegedly have been obvious to one of ordinary skill in the art at the time of the invention to replace the NiWP protection layer taught by Lee in view of Sambucetti with a NiReP protection layer because Whitlow allegedly teaches that, among other elements generically listed, the elements W and Re may be used for forming a copper diffusion barrier. (See Office action at p. 5, 11. 1-5.) In addition, the Examiner cites the abstract Aisaka as allegedly teaching that it was known at the time of the invention that NiReP films could be deposited by electroless plating for forming a resistor and, in addition, cites Semkow at column 5, lines 10-13 and 22, as allegedly teaching the use of a NiReP film as a corrosion protection layer. However, the Examiner has not applied a reference that employs a NiReP film in ULSI wiring as a barrier layer between an insulating layer and a wiring layer. Further, Semkow generally discloses NiReP among a long list of other possible alloys and provides one of ordinary skill in the art with no particular reason to select a NiReP for use as a diffusion prevention layer in USLI wiring. Further, the Examiner only appears to apply Aisaka and Semkow as support for the position that it was known in the art that it was possible to form a NiReP film. However, this fact alone does not provide one of ordinary skill in the art with any reason to select it for use in ULSI wiring for a diffusion prevention layer. In light of the above, Applicants submit that the Section 103 rejection is improper.

The Examiner respectfully disagrees with this argument. Lee et al does not limit nickel alloys as copper diffusion barrier. Sambucetti shows that a diffusion barrier layer 16 of a metal alloy material such as **Ni-W-P** *is suitable* for prevention of *copper diffusion* (See FIG. 1; column 5, line 61 to column 6, line 18). It is held that **the selection of a known material based on its suitability for its intended use supported a prima facie obviousness determination.** Sinclair & Carroll Co. v. Interchemical Corp., 325 U.S. 327, 65 USPQ 297 (1945). See MPEP 2144.07.

Therefore, one of ordinary skill in the art would have reasonable expectation of success (and, thus, motivation) in using Ni--W--P as a diffusion prevention film in Lee et al to provide the desired prevention of the first Cu layer from diffusing since Sambucetti et al teach that an electroless Ni-B film or Ni--W--P film is suitable for preventing Cu from diffusion, and Lee et al does not limit their teaching to particular Ni alloys.

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Whitlow et al teaches that **any element or alloy** which does not alloy with copper such as *tungsten* and *rhenium* may be used as a barrier to prevent *diffusion of copper* (See column 1, lines 51-65). Therefore, one of ordinary skill in the art would have reasonable expectation of success (and, thus, motivation) in using rhenium to alloy with nickel and phosphorus in Lee et al in view of Sambucetti et al instead of tungsten to provide the desired copper diffusion barrier since Whitlow et al teaches that either alloy of *tungsten* or alloy of *rhenium* may be used for forming copper diffusion barrier especially considering the fact that Ni-Re-P alloys were known and used in the art. Thus, the Examiner has established prima facie case of obviousness over the combination of cited references.

Therefore, in contrast to Applicants argument, a combination of references applied by the Examiner teaches the use of claimed NiReP film in ULSI wiring as a barrier layer between an insulating layer and a wiring layer.

(B) Applicants also submit that ULSI wiring having a diffusion prevention layer comprising a NiReP film provides unexpectedly superior properties as compared to ULSI wiring having a diffusion prevention layer comprising a NiWP film. In support of this position, Applicants have attached herewith a publication by Tetsuya Osaka et al. (hereinafter "Osaka et al.") that demonstrates the unexpected superiority of using a barrier layer comprising a NiReP plating film as compared to a barrier layer comprising a NiWP plating film. The patentability of the claimed subject matter is further supported because Otsaka et al. is direct comparison of the presently claimed invention to the closest embodiment shown in the art. Referring to FIG. 5, Otsaka et al. shows a comparison of various barrier films to one another. In particular, FIG. 5 shows the sheet resistance of NiWP/Cu and NiReP/Cu depending on the annealing temperature. In FIG. 5, it is apparent that the NiWP barrier layer suffers an undesirable increase in heat resistance after annealing at 200 °C or higher. A rise in sheet resistance occurs due to an interdiffusion of NiWP and Cu and, more specifically, represents that Cu starts adversely diffusing into the NiWP film. In contrast, a similar rise in sheet resistance is not seen in the NiReP barrier layer until about 400 °C. Thus, the claimed NiReP film is clearly superior to the NiWP film in view of sheet resistance. This result demonstrates that the interdiffusion of the NiReP film and Cu is prevented up to 400 °C and, consequently, because Cu is advantageously prevented from being diffused into the NiReP film, the claimed NiReP film provides excellent diffusion prevention properties for USLI wiring.

The Examiner respectfully disagrees with this argument. Osaka et al admitted that Ni-W-P films were not expected to have excellent thermal stability because the W content was only about 5%, which was insufficient to provide thermal stability (See Page C574, column 2, **Results**

and Discussions, P1-3). Osaka et al further admitted that a *small amount of heavy metal hardly affects the barrier property of the film* (See page C575, P 2). In other words, Ni-Re-P having the same 5% of Re as W in Ni-W-P would also be expected not having excellent thermal stability. Therefore, “unexpectedly superior properties” of Ni-Re-P having high content of Re were actually expected due to higher content of Re in the alloy. It should be noted that Osaka et al teaches they could not be increase W content above 5% while using electroless plating bath while using the same type of bath they were able to achieve high content of Re in the alloy, thus, giving the impression to readers that W had inherent property which would not allow to achieve higher content of W in the alloy. This is not so because US 3,485,597 discloses that **13% of W** could be easily achieved using electroless plating (See column 2, lines 32-48).

Since claim 7 does not recite the content of the Re in the Ni-Re-P alloy, claim 7 includes Ni-Re-P alloys having 5% **or less** of Re, which according to Osaka et al do not show unexpected thermal stability compared to Ni-W-P alloy.

Therefore, unexpected results were not shown for claimed scope of invention.

Conclusion

THIS ACTION IS MADE FINAL. Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

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Any inquiry concerning this communication or earlier communications from the examiner should be directed to Elena Tsoy Lightfoot whose telephone number is 571-272-1429. The examiner can normally be reached on Monday-Friday, 9:00AM - 5:30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Timothy Meeks can be reached on 571-272-1423. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Elena Tsoy Lightfoot, Ph.D.
Primary Examiner
Art Unit 1792

April 22, 2009

/Elena Tsoy Lightfoot/